REMARKS

In view of the above amendments and following remarks, reconsideration of the objections and rejections contained in the Office Action of June 29, 2004 is respectfully requested.

It is initially noted that a number of minor editorial changes have been made to the specification and abstract for the sake of form.

It is further noted that the Examiner objected to claim 15 for a lack of proper antecedent basis. However, original claims 1-27 have now been canceled and replaced with new claims 28-52. New claim 41 corresponds to prior claim 15, and avoids the antecedent basis issue raised by the Examiner.

The Examiner rejected claims 1-6, 10, 11, 13-15, 17, 18 and 20-27 as being anticipated by Kobayashi, U.S. Patent 6,250,378 (Kobayashi). Further, claim 19 was rejected as being unpatentable over Kobayashi by itself. Claims 7 and 8 were rejected by the Examiner as being unpatentable over Kobayashi in view of Tajima, U.S. Published Patent Application No. US2002/0067591 (Tajima). Claim 9 was rejected as being unpatentable over Kobayashi in view of Donahoe et al., U.S. Patent 5,757,615 (Donahoe). Claim 12 was rejected as being unpatentable over Kobayashi in view of Aguilera, U.S. Patent 5,606,341 (Aguilera). Claim 16 was rejected as being unpatentable over Kobayashi in view of Chu et al., U.S. Patent 6,674,642 (Chu). However, it is respectfully submitted that the present invention, particularly as now set forth in new claims 18-52, clearly distinguishes over all of the references cited by the Examiner.

In general, the present invention is directed to a computer that includes a casing having a display that is bordered by a frame. Particularly in industrial computers, the ambient conditions of use are detrimental to the operation of the electronic components of the computer, so the sealing integrity of the casing is very important. However, this greatly hinders dissipation of the heat produced by the electronic components. Passive heat exchangers such as internal and external cooling ribs are frequently inadequate, resulting in that active water cooling systems are generally used. Typically these are used with large external cooling bodies that serve as a heat exchanger. However, this increases the amount of space for the computer and requires external connections for the supply and discharge of water to the computer casing.

Thus the present invention has been developed to provide the frame of the display with a cooling fluid passage for the dissipation of heat. As computers of this kind are often installed in machine installations or in control desks so that only the display is exposed, providing the cooling passage in the frame, in the proximity of the display, makes sure that a satisfactory heat exchange between the interior of the casing and the surroundings can take place.

Note Fig. 2b illustrating passage 5 formed by the frame 2 extending around the display 4. As illustrated in this embodiment, the frame itself forms the passage for the cooling fluid. As discussed beginning on line 24 of page 1 of the original specification, this represents a particularly advantageous arrangement. When the passage for the cooling fluid is formed by the frame itself, and especially when the frame is of a single-wall nature, an optimal thermal coupling effect is achieved.

As discussed in the specification and reflected by various dependent claims, ribs 7 and 9 can be provided to enhance the cooling effect. Connecting portions 6 can be used to connect the interior of the casing with a passage 5 so that the cooling fluid can be conducted to the interior of the casing. Note for example the arrangements of Figs. 4a, 4c and 4d. These illustrate how the cooling fluid can be used to cool the electronic components on the inside of the casing, with the heat being dissipated through the frame surrounding the display 4.

The invention is primarily reflected by new independent claim 28. This claim represents in substance a combination of original claim 1 and original claim 3. Thus, the claim recites a computer comprising a casing having a display which is bordered by a frame. The frame has a passage arranged therein with a cooling fluid in the passage. The frame itself, further, forms the passage for the cooling fluid.

Similar limitations are contained in claim 48, directed toward the casing per se as with prior claim 22. This same concept is expanded upon in new independent claim 51, which simply makes a number of aspects of the invention even further explicit.

The remaining claims all depend from these independent claims. All of the claims clearly distinguish over Kobayashi.

In rejecting claims 1 and 3, the Examiner referenced the casing 51, display 7 and frame 12, wherein the frame is a passage 59 for a cooling fluid. The Examiner noted that the frame 12 itself

forms the passage for the cooling fluid. However, it is respectfully submitted that the Examiner is incorrect.

Reference number 12 refers to an external chassis of a lid 51. However, the passage 59 that is referenced by the Examiner is not formed by the chassis 12 itself. Rather, the passage 59 is formed by a thermo-siphon 6. While the thermo-siphon 6 can be integrated with a heat spreading board 5, it is not integrated with the chassis 12. Thus the chassis 12 does not itself form the passage for the cooling fluid.

With the present invention, as for example reflected by claim 28, the frame itself forms the passage for the cooling fluid. The frame for the display thus provides an excellent location for the cooling fluid without the necessity of any additional pipe disposed in the frame. However, in Kobayashi, the passage or passages 59 are provided by a separate member 6, which may be combined with a heat spreading board 5. However, it is not formed as part of the frame. If the chassis 12 forms the frame for the display 7 in accordance with the Examiner's interpretation of the structure as for example shown in Fig. 1, it is clear that the heat spreading board 5 and the thermo-siphon 6 are not part of the frame 12. Rather, they are separately attached to it as for example illustrated in Fig. 4. Thus Kobayashi does not disclose or suggest this feature.

Providing the passage with a cooling fluid in the frame, with the passage formed by the frame itself, is particularly advantageous for industrial computers in which the outside of the frame may be one of the few places that can effectively remove the heat from the overall casing. Note the earlier discussion.

The Examiner's position with respect to claims 5 and 6 is respectfully traversed. New claims 31 and 32 correspond to these claims. Reciting that the frame is made from an extrusion is effectively a recitation of specific structural characteristics that are the result of the extrusion process. Certainly, Kobayashi does not disclose an extrusion of a frame that itself forms a passage for the cooling fluid.

With respect to the Examiner's comments regarding claims 10 and 11, claims 36 and 37 recite connecting portions, and claim 37 recites exactly two connecting portions. The Examiner references number 36 adjacent "C" and an unnumbered element adjacent "A". It is assumed that the Examiner is referring to the embodiment of Fig. 39A of Kobayashi. However, these components referenced

by the Examiner do not extend into the casing 51 from a fluid passage and a frame in accordance with claims 36 and 37.

Similarly, heat exchanger 2 is not within the casing 51, noting claim 39.

In rejecting claim 16, the Examiner considers a fluid pump to be obvious in view of Chu. Chu does indeed provide a miniature circulation pump 22 for a liquid coolant, such as water. However, in Kobayashi, there is used a thermo-siphon. Thus a pump would be inappropriate with Kobayashi. It is also questionable whether water or distilled water would be a suitable cooling medium, as reflected by claims 44 and 45.

Indeed, there numerous additional features contained in the various dependent claims, whether specifically discussed above or not, which distinguish the present invention over the references that have been cited.

Additional attention is directed to independent claim 51 which recites the casing as having a frame which surrounds the display, and that the frame itself forms the passage for the cooling fluid. It forms the passage such that the passage at least partly extends around the outer periphery of the display. Thus, the claim is even more explicit with respect to the physical arrangement.

For all of the reasons outlined above, it is respectfully submitted that new claims 28-52 clearly distinguish over Kobayashi and the additional references cited by the Examiner. More explicit discussion of the additional references cited by the Examiner does not appear to be necessary at this time in view of the above clear differences. However, Applicants reserve their rights to argue against the combinations of references made by the Examiner should such be necessary and appropriate, and no acquiescence to the positions taken by the Examiner should be assumed.

In view of the above it is submitted that all of the claims pending in the application are now clearly in condition for allowance. Indication of such is respectfully requested.

In view of the above amendments and remarks, it is submitted that the present application is now in condition for allowance, and the Examiner is requested to pass the case to issue. If the Examiner should have any comments or suggestions to help speed the prosecution of this application, the Examiner is requested to contact Applicants' undersigned representative.

Respectfully submitted,

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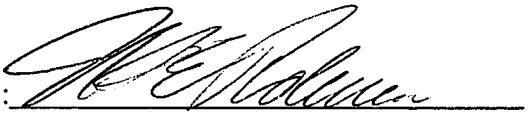
By: 

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A Cooled Computer Casing Display Frame

Background of the Invention

The present invention concerns a computer, in particular an industrial computer, comprising a casing having a display which is bordered by a frame.

As computers of that kind are generally used in surroundings with ambient conditions which are detrimental to the operation of electronic components, the sealing integrity of the casing plays an extremely important part. A problem which arises in this connection is that a sealed casing greatly hinders dissipation of the heat which is inevitably produced in operation of electronic components, so that in an extreme situation it can even happen that electronic components are destroyed. As passive heat exchangers in the form of internal and external cooling ribs are frequently inadequate, an active water cooling system is generally used, with a large external cooling body which serves as a heat exchanger. This ~~That~~ disadvantageously increases the amount of space for ~~of~~ such a computer. In addition, external connections for the supply and discharge of water have to be provided on the computer casing, which always involves the risk of water escaping.

Summary of the Invention

The object of the invention is to provide an arrangement of the general kind set forth, in which the above-discussed problems of the state of the art do not occur.

According to the invention, ~~that~~ this is achieved in that disposed in the frame is a passage – preferably extending therearound – for a cooling fluid.

As computers of the general kind set forth are preferably installed in machine installations or control desks in such a way that only the display is exposed, the arrangement according to the invention of the cooling passage in the frame in the proximity of the display ensures that a satisfactory heat exchange between the interior of the casing and the surroundings can take place.

A particularly preferred embodiment of the invention provides that the frame itself forms the passage for the cooling fluid, which represents a particularly advantageous way of implementing the arrangement according to the invention. That is the case in particular when at least the frame and preferably the entire casing is

produced from an extrusion. That manner of manufacture permits particularly simple dimensioning of the casing, whereby it is suitable for accommodating displays of the most widely varying sizes. In order to alter the dimensions of the casing according to the invention, in regard to a casing produced using an extrusion process, the desired cut length of the individual parts (preferably four) is simply selected, and those parts are then joined together by an adhesive, for example a two-component adhesive. In that respect, the casing can be produced in one piece, or it is possible to produce only the frame and the side walls adjoining it in one piece. A panel which seals off the computer at its rear side can in the latter case be produced separately and joined to the rest of the casing.

In the case of a frame or casing produced in accordance with the state of the art by a casting process, a suitable casting mould would have to be produced for each desired dimensioning, which ~~and that~~ involves major costs.

If the passage for the cooling fluid is formed by the frame itself, it is particularly advantageous for the frame to be of a single-walled nature, as that affords an optimum thermal coupling effect between the cooling fluid flowing in the passage and the ambient air around the computer.

A further advantageous embodiment of the invention provides that arranged on the casing are cooling ribs which project outwardly and/or into the interior of the casing. Cooling ribs of that kind improve the heat exchange between the interior of the casing and the area surrounding the computer. The ~~That~~ heat exchange effect can be still further improved in an advantageous manner by cooling ribs being arranged at least in a portion-wise manner at the inside of the passage.

A further particularly preferred embodiment of the invention provides that connecting portions which project into the interior of the casing are arranged on the cooling passage. That makes it possible to produce a fluid-conducting communication (for example a hose connection) between the passage arranged in the frame and heat exchangers arranged on ~~in~~ the interior of the casing on individual components.

A further advantageous embodiment of the invention provides that just two such connecting portions project from the cooling passage into the interior of the

casing, wherein they are preferably arranged at the top side or the underside of the frame, preferably centrally. If a fluid-conducting communication is produced with a heat-generating component on ~~in~~ the interior of the casing by way of those two connecting portions, then naturally occurring convection will already provide for a satisfactory circulation of the cooling fluid in the cooling passage without a pump being required to maintain the circulation.

After the cooling fluid has received the heat from the electronic components it rises of its own accord due to its lower density in the direction of the upper connecting portion from where it passes into the cooling passage and continues to flow horizontally along both sides. In doing so it gives off its heat to the area surrounding the industrial computer, which increases its density, so that at the two vertical portions of the cooling passage, under the force of gravity, it passes into the lower horizontal region of the passage. From there it is urged by the fluid flowing thereafter, by way of the lower connecting portion, upwardly again to the heat-generating component, whereby the cooling circuit is closed.

A further advantageous embodiment of the invention provides that the cooling fluid is a liquid, for example water. Preferably distilled water can be used to reduce the formation of deposits in the cooling passage. In that respect it is preferably provided that introduction of the cooling fluid, more especially water, is already effected at the factory upon assembly of the computer casing. Throughout the entire service life of the computer casing according to the invention, in that case, no change in the cooling fluid is intended, so that it is possible to completely eliminate external connecting portions.

In a further advantageous embodiment of the invention it is provided that the display is in the form of a touch display. That makes it advantageously possible to eliminate the provision of a specific keyboard for operating the computer according to the invention.

If a plurality of heat-generating components or a few components involving the generation of a large amount of heat are to be incorporated into the cooling circuit according to the invention, an advantageous embodiment of the invention can provide that at least one pump for circulating the cooling fluid in the cooling circuit is

arranged on ~~in~~ the interior of the casing. That ensures a satisfactory heat exchange even when a very large amount of heat is developed.

The present invention not only concerns a computer of the general kind stated, ~~as set forth in claim 1~~ but also a casing with or without a rear panel for electronic components, in which no electronic components are yet installed, and a method of cooling electronic components in such a computer or casing, in which the cooling fluid circulating in the frame is passed by way of a fluid-conducting communication into the interior of the casing for cooling at least one electronic component – preferably at least the CPU.

Brief Description of the Drawings

Further details of the invention can be seen from the specific description hereinafter. In the ~~drawing~~ drawings:

Figures 1a, 1b, 1c and 1d show a perspective view, a front view, a side view and a rear view of a computer according to the invention,

Figure 2a shows a front view of a computer according to the invention,

Figure 2b shows a view in section through a computer according to the invention taken along line ~~plane~~ A-A in Figure 2a,

Figure 2c shows a detail view of Figure 2b,

Figure 3 shows a plan view of a computer casing according to the invention with the rear casing panel removed,

Figure 4a is a diagrammatic view showing a ~~the~~ cooling circuit in a computer according to the invention,

Figure 4b shows a perspective diagrammatic view of a detail from Figure 3a,

Figure 4c shows a further diagrammatic view of the cooling circuit in a computer according to the invention when supplying a plurality of electronic components,

Figure 4d is a plan ~~perspective~~ view of the cooling circuit in a further embodiment of a computer according to the invention, and

Figure 5 shows a computer according to the invention in an ~~the~~ installed condition.

Detailed Description of the Preferred Embodiments

Figure 1a shows a housing 1 according to the invention of an industrial computer 16 with a display 4 which is bordered by a frame 2. Figure 1b is a front view of the same casing 1. The side view in Figure 1c very clearly shows ~~the~~ cooling ribs 7 according to the invention, which are on the outside of the casing. Figure 1d shows a rear view looking onto the casing 1 according to the invention, wherein it is possible to see a ~~the~~ panel 3 which seals off the casing 1 at the rear side thereof.

Figure 2b is a sectional view of the casing 1 according to the invention along line A-A of ~~the plane A in~~ Figure 2a. It is possible in particular to clearly see the arrangement according to the invention of a ~~the~~ cooling passage 5 in the frame 2 of the casing 1. In this embodiment the cooling passage 5 is formed by the frame 2 itself. In this embodiment the frame 2 and thus the cooling passage 5 are of a single-wall configuration. In the illustrated embodiment the casing 1 is produced by an extrusion process. Cooling ribs 7 on the outside of the casing and cooling ribs 8 on the inside of the casing improve heat exchange with the ambient atmosphere if the industrial computer 16 is not fitted directly into an installation 17 but has a certain lateral clearance. In this embodiment there are two connecting portions 6 for producing a fluid-conducting communication 13 (not shown in this Figure) into the interior 18 of the casing. The arrangement of those connecting portions 6 is advantageously implemented as illustrated, wherein one connecting portion 6 is arranged at a ~~the~~ top side 2' of the frame and the other connecting portion 6 is arranged at an ~~the~~ underside 2" of the frame, approximately centrally. It is also possible to see diagrammatically illustrated electronic components 10 which are fixed on ~~in~~ the interior 18 of the casing in a manner with which the man skilled in the art is familiar. It is also possible to see ~~the~~ cooling ribs 9 which are provided at ~~the~~ an inward side of the passage 5 and which serve for further improving heat exchange. The rear side of the computer 16 is sealed off by a panel 3, an inserted sealing ring 20 being apparent more especially in Figure 2c.

In Figure 3 the panel 3 at the rear side of the casing has been removed~~,~~ to permit a view into the interior 18 of the casing. It is possible to see the central arrangement of the connecting portions 6 disposed at the top side 2' and the underside 2" of the frame, together with a heat exchanger 12 having two connections 21, 22

which can be connected to the connecting portions 6 by way of a fluid-conducting connection 13 (not shown). It is further possible to see various diagrammatically illustrated electronic components 10, inter alia a motherboard 19.

Figures ~~Figure~~ 4 show ~~shows~~ once again the mode of operation of the cooling system according to the invention, in various embodiments:

Figure 4a, which is a diagrammatic view of ~~onto~~ the rear of an industrial computer 18 according to the invention, shows a cooling circuit in which a heat exchanger 12 is arranged on ~~in~~ the interior 18 of the casing over the CPU 11 of the computer 16, through which flows the cooling fluid circulating in the frame. After the cooling fluid has absorbed heat in the heat exchanger 12, which for example is in the form of a hollow copper or aluminium member with two connections, and the cooling fluid has thereby experienced a reduction in its density, it rises against the force of gravity through the hose connection 13, illustrated by way of example, to the connecting portion 6 which is arranged at the top side 2' of the frame, without the support of a pump being necessary for that purpose. After passing into the cooling passage 5 in the region of the top side 2' of the frame, the cooling fluid is involved in a further horizontal movement on both sides along the horizontal top side 2' of the frame, in which case the cooling fluid continuously gives off heat to the surroundings of the computer 16 and in so doing increases its density again. The cooled cooling fluid drops by way of the two vertical regions of the cooling passage 5 to the underside 2" of the frame, from where, due to the fluid urging it onward, it passes by way of the connecting portion 6 arranged at the underside 2" of the frame into the interior 18 of the casing again, into the lower hose conduit 13 and thus to the heat exchanger 12 again. This ~~That~~ closes the cooling circuit.

Figure 4b is a diagrammatic view showing in detail the arrangement of the heat exchanger 12 at the top side of the CPU 11 which is arranged on a motherboard 19. It will be appreciated that it is also possible to envisage design configurations of heat exchangers 12 which completely enclose the electronic components and thus provide for improved dissipation of heat.

Figure 4c is also a diagrammatic view of a further embodiment of an industrial computer 16 according to the invention, wherein, unlike Figure ~~3a~~ 4a, a plurality of

diagrammatically illustrated electronic components 10 on ~~in~~ the interior 18 of the casing are in fluid-conducting communication by way of hose connections 13 with the two connecting portions 6. Particularly in the case of large installations, it can certainly be provided that a pump 15 is arranged in the interior 18 of the casing, to improve the heat exchanger effect. It can be seen from Figure 4c ~~3c~~ that, even when supplying a plurality of electronic components 10, two connecting portions 6 may be sufficient if a hose divider 14 is used.

Figure 4d diagrammatically shows a further embodiment of an industrial computer 16 according to the invention, in which there are two mutually separate cooling circuits for supplying electronic components 10 (in the example illustrated here two CPUs 11). In the illustrated example four connecting portions 6 were provided for the ~~that~~ purpose, of ~~for~~ passing fluid into the interior 18 of the casing.

Figure 5 diagrammatically shows an industrial computer 16 according to the invention, which was fitted into an installation 17 in such a way that only the frame 2 and the display 4 are in contact with the surroundings. The arrangement of the cooling passage 5 in accordance with the invention means that this is already sufficient for adequate cooling of the electronic components 10 (not shown in Figure 4) ~~in~~ on the interior 18 of the casing of the industrial computer 16 according to the invention.

Details and operating procedures which are familiar to the man skilled in the art have not been described and illustrated in the specific description and the Figures.

Abstract

~~A computer comprising a casing having a display which is bordered by a frame, wherein arranged in the frame is a passage for a cooling fluid.~~ A computer has a casing housing a display, and a frame of the casing borders the display. A cooling passage is provided in the frame and has a cooling fluid therein. The frame itself forms the passage for the cooling fluid. By connecting the passage with the interior of the casing, so as to for example cool electronic components therein, effective cooling of the computer is carried out by distributing the heat through the frame of the display.

~~(Figure 1)~~